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POLLUTION OF A STREAM BY WASTE FROM A HYDROGEN GENERATING PLANT[1]

By Edward Bartow[2] and A. S. Behrman[3]

With the influx of American troops into Brest the problem of furnishing sufficient water for the troops arose. Likewise water must be obtained for the troopships. As the value of a troopship was estimated at $15,000 a day, it was necessary to make every effort to provide sufficient water.

When Brest was chosen as a port of entry for American troops, there was only sufficient water supply for the inhabitants of the city and for the French naval station located there. The city and the naval station were furnished with water from gathering galleries located in the neighboring hills. The water flowed by gravity to the city and to the naval station, there being several independent supplies in use. Elevated tanks were connected with each system. The barracks at Pontanesan to which the American troops were assigned, were served by water from a spring which was filtered through trickling filters of sand.

To supply the additional supply needed, water from a stream, Penfeld River, was the best available. Contracts were made with the French navy that this water could be used, provided it were of as good bacterial quality as the water in use by the French, and also that it should have no taste or odor. A reservoir formerly used as a mill pond was enlarged and cleaned out by the American troops. Three hundred pounds of calcium hypochlorite was spread over the bottom and the water allowed to enter, forming a fairly concentrated solution. After this solution was replaced with better water, liquid chlorine was added to the effluent at the pumping station. An old pump and boiler were procured from the French and a temporary shed constructed to protect it. Comparative tests made by the chemist and bacteriologist at the naval station and by representatives of the water analysis laboratories, showed that the sterilization was satisfactory and the water was allowed to enter the mains.

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[1] Read before the Chemical and Bacteriological Section of the Cleveland Convention, June 9, 1921. Discussion is invited and should be sent to the Editor.

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An extension was made from the naval station mains to the Port de Commerce and the pier from which water could be carried to the American ships. It later became necessary to build an additional reservoir and to construct an independent line from this reservoir to the Pontanesan barracks and to the American pier. Not enough water could be passed through the French naval station system to supply the boats rapidly. Several batteries of hydrants, two 4-inch hydrants and four 2-inch hydrants were in use. From these batteries a tank boat of 800 tons of water capacity could be quickly filled and the water transferred rapidly to the transports at anchor in the harbor.

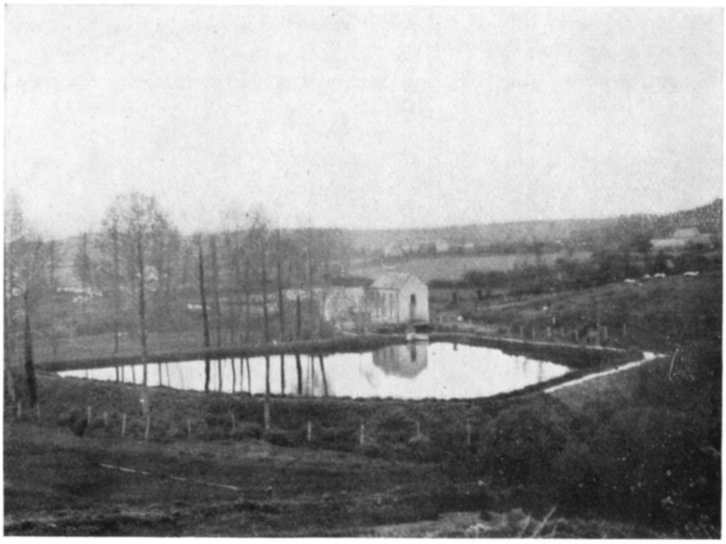

FIGURE 1

Soon after the use of the water began, on June 22, 1918, after the first heavy rain following the most prolonged dry season of many years, the water in Penfield River developed an intense amber color and a disagreeable taste. The bacterial results were also unsatisfactory, and the use of the water had to be discontinued. The alkalinity increased from 13 to 110; the chloride content which would naturally fall as the water rose, showed a very small fluctuation, changing from 35 to 39. Both of these tests would indicate special contamination accompanying the increase in the quantity of water flowing in the river. An inspection of the watershed showed only one branch with an unusual color. This had its beginning at a point 11 kilometers northeast of Brest, where had been recently installed a French aviation station where hydrogen for the dirigible balloons was being made by the action of ferro-silicon on caustic soda. For several months the waste products from this process, highly colored and strongly alkaline, had been dumped into the head waters of this branch of the Penfeld River. During the long dry season there had not been sufficient dilution to carry the wastes to the main stream and they had, therefore, accumulated by evaporation and sedimentation. The heavy rain washed down large quantities of these products, resulting in the general poisoning of fish in the upper portion of the stream, and causing the changes in the water at the pumping station as indicated.

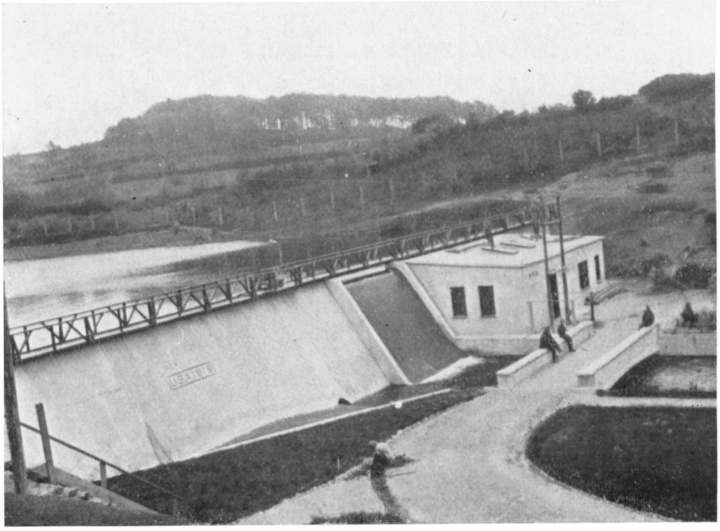

FIGURE 2

Arrangements were made at once with the French authorities to prevent refuse from entering Penfeld River by collecting it in concrete basins which had been constructed; one of which was already under construction in connection with a proposed plan for the partial recovery of soda in the refuse. From the concrete basins the refuse would be used in soda recovery or else hauled to the sea at a distance of about 8 kilometers. In order to prevent trouble from the objectionable material already impregnated in the soil and collected in the marshy region just below the aviation station, a sluice gate was constructed above the reservoir which could be closed when the intake water became objectionable.

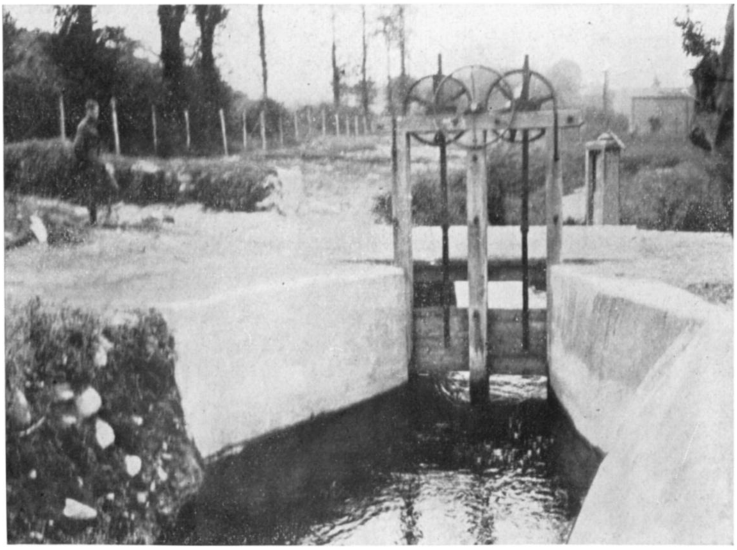

FIGURE 3

Since the reservoir held several days' supply for the pumps this would ordinarily tide the plant over until the intake water cleared up. A similar sluice gate and a diversion canal were constructed to bypass water at the new reservoir. It was also arranged to store bad water at a time of heavy rains in an abandoned mill pond about 2 kilometers below the aviation station. This reservoir would hold about two days' run off after fairly heavy rains. In case it should become necessary to use the colored alkaline water, as it was absolutely necessary to supply the allied shipping in the harbor with water, arrangements were made and material secured to treat the water in the upper part of the watershed with alum to clarify and decolorize, and lower down to treat with sulfuric acid to neutralize the alkali. Fortunately, the measures indicated above were not found necessary. Dry weather again set in and normal conditions were reestablished. It was necessary, however, to increase the liquid chlorine from 1.2 to 2.5 parts per million. After a total shut down of eight days the bacteriological examinations showed that the required standard was again reached and the water was again pumped into the mains. It is interesting to note that even at times of maximum pollution when hydroxides (caustic alkalinity) of the water taken from stream about two kilometers from the aviation station were equivalent to a 0.1 per cent solution of sodium hydroxide, the caustic alkalinity had disappeared entirely by the time the water reached the Penfeld reservoir, being converted by reaction with the carbonate in the water and by contact with the water from the other branches and with the carbon dioxide of the air into the bicarbonates.

The liquid chlorine sterilization, under daily control of the laboratory gave water which was of satisfactory quality, available both for the transports and for the camp at Pontanesan, which at times held as many as 80,000 men.